

Interface Control Document SI Handling Cart to SSMO Facility SIC_SSMO_01

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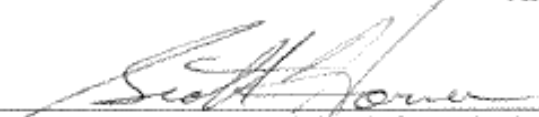
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REVISIONS

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INTERFACE CONTROL DOCUMENT SI HANDLING CART TO SSMO FACILITY SIC_SSMO_01

1. SCOPE

1.1. Purpose

The purpose of this ICD is to document all interface requirements between the Science Instrument Cart (SIC) and the SSMO Ground Support Facility located at Dryden Aircraft Operations Facility (DAOF) in Palmdale, CA. This is one of two interface control documents that describe the interface of the SI Cart to the Aircraft System (SIC_AS_01) and to the ground facility (this ICD). There previously existed a third SIC interface control document, SIC_SI_01, which described the interface of the program provided Science Instrument Cart to the Science Instrument. SIC_SI_01 has since become obsolete and SI teams will instead provide their own SI carts. The terms SI Cart and SI Handling Cart are used here synonymously.

2. REFERENCE AND APPLICABLE DOCUMENTS

The latest revisions of the following documents form a part of this requirement to the extent specified herein.

2.1. SOFIA Documents

PD-2009	SOFIA Lexicon
SOF-AR-ICD-SE03-205	Interface Control Document SI Handling Cart to Aircraft System, SIC_AS_01
SOF-L3-ICD-SE03-002	GLOBAL_09, SI Instrument Envelope
SOF-L3-ICD-SE03-004	GLOBAL 7, Aircraft Floor Loading Interface Requirements
USRA-DAL-1026-00	Requirements Document for Building Site 9
USRA-DAL-SSMOC-MOPS-TN-0500	Early Science Laboratory Facilities
SOF-AR-PLA-PM17-2000	SOFIA Science and Mission Operations Plan

2.2. Standards

DI-E-30141	Interface Reference Document
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3. INTERFACE REQUIREMENTS

This ICD documents all the constraints associated with the ground facility as a fully loaded SI Cart moves from one of five Instrument Readiness Rooms (IRR) or the Pre-flight Integration Facility (PIF) to the Aircraft Door.

The physical, functional, and safety requirements of the SI Cart are determined by the physical limitations of the aircraft system and ground facility. Interface control document ICD SIC_AS_01 describes in detail the requirements to ensure safe transportation of the SI Cart through the aircraft. A subset of key requirements from SIC_AS_01 is repeated in section 3.2 of this document to accurately define the SI Cart interface with the SSMO Ground Support Facility. The SI Cart will be used to transport the Science Instrument with an instrument weight not to exceed 1322.7 lb [600 kg], the maximum allowable weight for a science instrument.

The Instrument Readiness Rooms are designated rooms where Science Instrument teams will work on Science Instruments. The Pre-flight Integration Facility serves as the alignment and calibration facility for Science Instruments. A Science Instrument team will move a Science Instrument from an IRR to the PIF as needed before moving the instrument to the aircraft for installation. IRR1 through IRR3 have double doors that connect directly to the PIF. IRR1 is also connected through another set of double doors to a 7-foot-wide hallway. IRR4 and IRR5 both connect to a hallway that is 6 foot, 5.5 inches wide. IRR3 is also connected to this same hallway. The PIF, IRR2, IRR3, and both hallways all have double doors that lead directly to the hangar area. Figure 1 provides the appropriate section of DAOF first floor with designated IRRs and PIF shown. During Early Science, IRR1 and IRR2 will be used as Early Science Lab #1 and Early Science Lab #2 respectively.

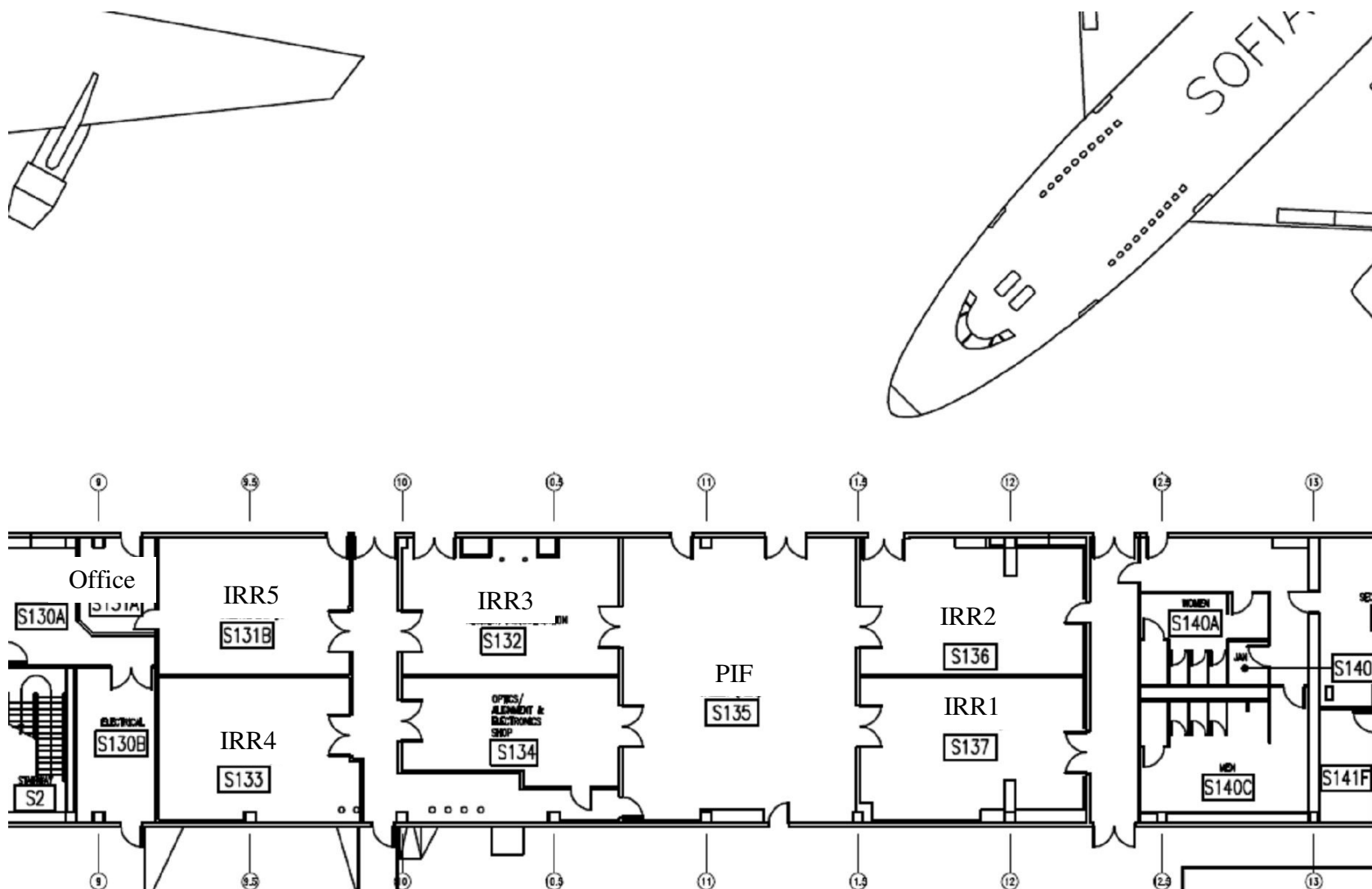


Figure 1: DAOF first floor with Pre-flight Integration Facility (PIF) and five Instrument Readiness Rooms (IRR) shown.

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3.1. Physical

The following physical items will be controlled as part of this ICD.

3.1.1. IRR and PIF

The IRR and PIF are available for Science Instrument work and loading of the SI Cart.

- A) There are two sizes of double doors in the IRR and PIF with different heights. In Figure 1 above, the double doors connecting the PIF with IRR1, IRR2, and IRR3 have a height of 7 feet and width of 5.5 feet. The other double doors shown in the figure have a height of 9 feet and width of 5.5 feet.

Tall Double-Door Dimensions:

Height: 9 feet
Width: 5.5 feet

Standard Double-Door Dimensions:

Height: 7 feet
Width: 5.5 feet

- B) The SSMO Ground Support Facility is equipped with a Pre-flight Integration Facility (PIF) and five Instrument Readiness Rooms (IRR). Table 1 lists the dimensions of each room.

Room	Area	Height
PIF	34 feet x 29 feet	11 feet, 10 inches
IRR1	20 feet x 32 feet	11 feet, 10 inches
IRR2	19 feet x 32 feet	11 feet, 10 inches
IRR3	19 feet x 31.5 feet	11 feet, 10 inches
IRR4	20 feet x 25 feet	11 feet, 10 inches
IRR5	19 feet x 25 feet	11 feet, 10 inches

Table 1. IRR and PIF dimensions.

Note: There are two structural braces that protrude into the space of IRR1 and IRR2. For more information and floor plan diagrams refer to USRA-DAL-SSMOC-MOPS-TN-0500.

- C) The floors of the IRR and PIF are made of concrete slab-on-grade with a vinyl composition tile surface. These floors can support 10,000 lbs concentrated load.

3.1.2. Hangar Floor

Hangar Floor Loads:

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The floor in the hangar is thick concrete capable of withstanding a concentrated load of 10,000 lbs. The surface is smooth cement.

Constraints:

There are five, 42-inch wide troughs that traverse both the length and width of the hangar floor at regular intervals. These troughs are covered by steel grates with rectangular spaces of 1 inch x 3.5 inch. A cover is being fabricated for the SI Cart to roll over these grates although in the movement from the IRR and PIF to the SOFIA aircraft the cart will not encounter them; however, it is encouraged that the wheels of the SI Cart be large enough to override this concern. The troughs can be seen in Figure 2, two across the width and three across the length of the hangar.

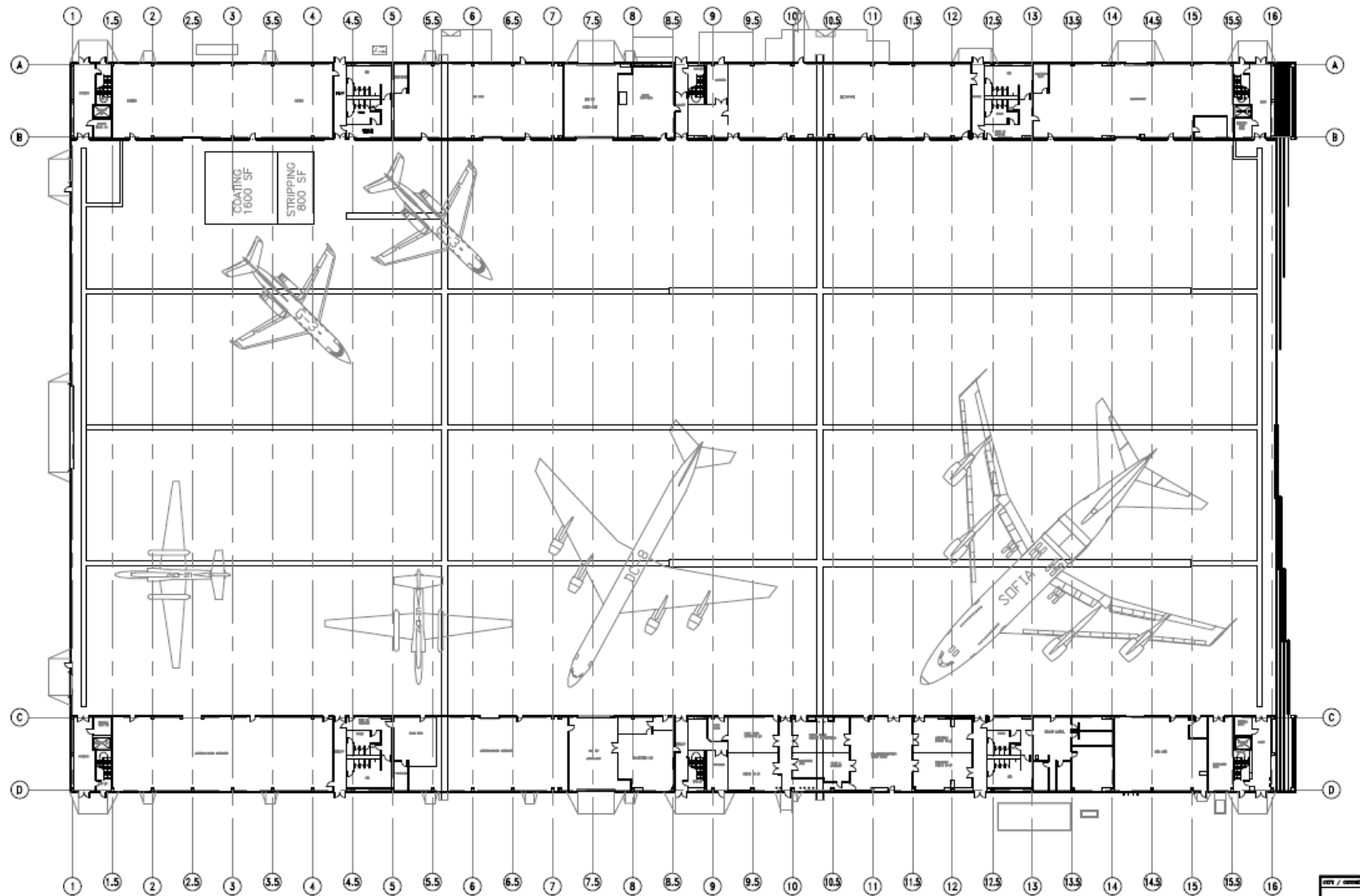


Figure 2: Hangar trough locations.

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3.1.3. Lift Truck Loading Restraints

The Science Instrument on the SI Cart will be loaded onto the SOFIA aircraft using a lift-bed truck which will raise the equipment up to the aircraft door. The bed has protective railings and personnel representatives will ride up with the equipment to ensure its safety. The Cart will be secured to d-rings installed in the bed. The truck bed is fairly large, but maneuverability may be limited.

- A) Lift Truck Dimensions:
- | | |
|----------------|--------------------|
| Area: | 18.5 feet x 8 feet |
| Load Capacity: | 10,000 lbs |

In order to get the SI Cart/SI configuration onto the lift-bed it will either be placed on the truck lift gate or fork-lifted onto the bed.

- B) Lift Gate Information:
- | | |
|------------------|--|
| Area: | 8 feet x 47 inches |
| Tilt: | As lifted, the gate becomes tilted towards the truck bed. At the final meeting point between lift gate and truck bed the angle is approximately 5 degrees. |
| Lip: | There is a beveled lip on the gate that facilitates movement of SI carts onto the lift gate that SI carts will encounter. |
| Securing Points: | Four d-rings placed at each corner of the lift gate to which the cart will be secured |
| Load Capacity: | 2000 lbs |
- C) Fork Lift Information:
- | | |
|------------------|--|
| Fork Length: | 8 feet |
| Fork Width: | Fully adjustable |
| Load Capacity: | 6000 lbs |
| Securing Points: | Cart will be tied to the forks with straps |

If the combined weight of the Science Instrument and SI Cart exceeds 2000 lbs, they will be transported to the lift truck using the fork lift.

3.2. Functional

The following functional items will be controlled as part of this ICD.

- A) The loaded cart shall be able to maneuver through constricted passageways in the SSMO Ground Support Facility and aircraft. In order to ensure that the loaded SI cart will be able to be transported through the designated areas of the ground facility and aircraft, the dimensions shall be chosen such that they comply with the maximum SI installation

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envelope as stated in SOF-L3-ICD-SE03-002, Global_09. This envelope is the maximum volume allowed for the installation of the SI and includes the SI, the SI cart, and all additional payloads that are placed on the cart. No elements shall extend beyond this envelope. First-generation science instrument carts shall utilize at least two swiveling casters, and swiveling casters at all locations if the cart is longer than 65 inches. Non first-generation science instrument carts shall utilize swiveling casters at all wheel locations. In addition, the rear casters or wheel mounts shall be positioned so that their rear-most point is no more than 69 inches [1752.6 mm] behind the front of the SI installation envelope. The maximum SI cart footprint shall be 30 inches with a minimum cart deck vertical clearance height of 6 inches.

- B) The loaded cart shall be able to negotiate 7-degree ramps with all wheels maintaining contact with the floor.
- C) The cart shall not damage the ground facility or aircraft floor structure by its usage. Each caster shall not exceed 500 psi on the floor when the cart is loaded. See SOF-L3-ICD-SE03-004 GLOBAL_07, for more detailed floor loading information. The loaded cart shall not exceed 600 pounds [272 kg] per caster. A minimum distance of 24 inches [609.6 mm] shall be maintained between all caster or wheel mounting locations.

3.2.1. Electronics

Not Applicable

3.2.2. Electrical Power

Not Applicable

3.2.3. Hydraulic, Pneumatic, Pumping, and Water Systems

Not Applicable

3.3. Environmental

Not Applicable

3.4. Safety

In order to safeguard the aircraft, the SI, the SSMOC facilities, and most importantly, the people using the SI Cart, certain precautions must be taken when transporting the SI in the cart. This section will detail possible safety hazards and how to deal with them. It will also detail some of the safety features required in the cart and give proper usage requirements.

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3.4.1. Floor Panel Failure

The manner in which the cart is loaded is critical due to the floor loading limitations as given in section 3.1. Therefore, the cart must be loaded in a manner which will ensure that no wheel carries more than this weight. If these requirements are not followed, the floor could be damaged causing the cart to become unstable and tip over. This could lead to equipment damage and injury to personnel.

3.4.2. Cart Maneuvering

Due to the heavy nature of the large science instruments, great care shall be taken when maneuvering the loaded cart. If care is not exercised, serious damage and injury may result.

CAUTION

**EXCEEDING INSTRUMENT CART WHEEL
DESIGN, LOAD CAPACITY, OR OPERATING
THE CART OUTSIDE OF THE INTENDED CART
PATH WILL RESULT IN FLOOR DAMAGE AND
CAUSE CART INSTABILITY LEADING TO PERSONNEL
INJURY OR DAMAGE TO SCIENCE INSTRUMENTS**

Therefore, the following precautions shall be followed:

- There shall be sufficient personnel controlling the cart so that no one person must exert unsafe levels of force.
- Caution must be used when using ramps within the SSMO to maintain control of the SI Cart. Each SI Cart shall have a braking system for at least two wheels that will be automatically activated when a SI Cart user is not in control of the SI Cart's motion.
- The SI shall be mounted on the cart in a stable position so that the risk of tipping is minimized.
- Great care should be exercised when pushing the long side of the cart. The cart should only be pushed from the short side to minimize the risk of tipping.

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3.4.3. Securing the Cart

The wheels that are chosen shall have the following safety features built into them:

- They shall have the ability to be restrained with wheel brakes or chocks for when the SI cart is parked for an extended period of time. This restraining system is in addition to the automatic braking system stated in section 3.4.2.
- Swiveling casters shall have the ability to lock into fixed, angular positions. This feature will be beneficial when the cart is being transported through narrow passageways by keeping the cart headed in a consistent direction.
- Casters with these features can be acquired through many manufacturers including Albion Industries Inc., E.R. Wagner Manufacturing Co., Hamilton Caster & Mfg. Co., and Payton Caster Inc. All of these companies can be accessed via the Internet.

4. QUALITY ASSURANCE PROVISIONS

During the process of moving the SI mounted on the SI Cart onto the aircraft the SOFIA QA team at DAOF will be observing to ensure no oversights are made.

5. ACRONYMS

The definitions, abbreviations, and acronyms used in this document are referenced in the SOFIA Lexicon, PD-2009.

C.G.	Center of Gravity
DAOF	Dryden Aircraft Operations Facility
ICD	Interface Control Document
INF	Instrument Flange
IRR	Instrument Readiness Room
PIF	Pre-flight Integration Facility
SI	Science Instrument
SIC	Science Instrument Cart
SOC	SOFIA Operations Center
SSMO	SOFIA Science and Mission Operations
TA	Telescope Assembly
TBR	To be Reviewed

6. NOTES

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